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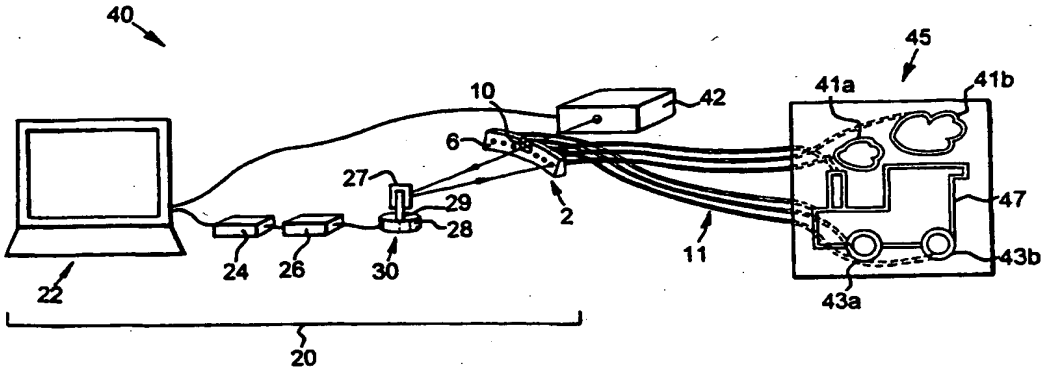

(57) Abstract

Apparatus and method for illuminating edge–emitting optical fibres for producing a changeable or animated visual display. The apparatus includes a fibre positioning head (2) into which a plurality of optical fibres (11) are located. Using a controllable steerable mirror (30), light from a laser source (42) is directed into the optical fibres (11) in a predetermined arrangement or sequence. The optical fibres (11) are arranged in a predetermined pattern or configuration to form a visual display (45) such that when the optical fibres (11) are illuminated in the predetermined arrangement or sequence, different parts of the visual display are illuminated to give the perception of animation to an observer.

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OPTICAL FIBRE ILLUMINATED DISPLAY APPARATUS

The present invention relates to apparatus for use with illuminated displays and particularly, but not exclusively, to apparatus for illuminating edge-emitting optical fibres for producing a changeable or animated visual display.

Animated visual displays may currently be provided by cinematography or large video screens as commonly seen at large concerts and live performances. Cinematic images are projected on a screen and usually require a darkened environment for the images to be viewed. Large video screens are bulky and expensive to manufacture.

Side emitting fibre optics can provide light emission over a relatively long length of fibre and, in the corresponding application WO 98/45645, a portable illumination system is described which provides light emission from a side-emitting fibre optic several kilometres in length using a laser source. Such a system has applications in emergency lighting for stairwells, cinemas, aircraft and the like. Though relatively inexpensive and portable this illumination system is limited to illumination of a single edge-emitting optical fibre.

It is an object of the present invention to provide an optical fibre illuminated display apparatus which obviates or mitigates at least one of the aforementioned problems.

This is achieved by providing a fibre optic positioning head into which a plurality of optical fibres are located. Using a controllable steerable mirror, light from a laser source is directed into the optical fibres in a predetermined arrangement or sequence. The optical fibres are arranged in a predetermined pattern or configuration to form a visual display such that when the optical fibres are illuminated in the predetermined arrangement or sequence, different parts of the visual

display are illuminated to give the perception of animation to an observer.

According to a first aspect of the present invention there is provided a fibre optic positioning means for an optical scanner used with display apparatus said positioning means comprising a structure with a plurality of locating means for receiving and locating a plurality of optical fibres in a predetermined array to position optical fibre ends for illumination by a directed light beam.

The locating means may be provided by a plurality of fibre optic guide apertures disposed in said structure. Preferably the structure has first and second surfaces parallel to each other. Conveniently the plurality of fibre optic guide apertures are located between the first surface and the second surface, and are disposed in a common plane in said structure.

The optical fibre ends are located within each fibre guide aperture to align the optical fibre ends with the first surface.

Preferably the or each locating means includes securing means to secure the optical fibres in the respective fibre guide apertures. The securing means may be provided by a threaded aperture in which a screw is located for securing the optical fibre in the fibre guide aperture. Alternatively the securing means may be an adhesive material.

Conveniently, an optical component, such as a lens, may be mounted within each fibre guide aperture near the first surface to focus the light into the fibre optic end.

Preferably the first and second surfaces are curved. Advantageously the fibre guiding apertures are located equidistantly apart and on the same plane in said structure.

Advantageously the fibre positioning head includes at least one non-reflecting light absorbing surface area so

that the light may be directed at the non-reflecting light absorbing surface area when illumination of the optical fibre ends is not required.

Preferably the first surface includes the non-reflecting light absorbing surface. The light incident on the fibre positioning head may be directed at the non-reflecting light absorbing surface when illumination of the fibre optic ends is not required. The non-reflecting light absorbing surface may comprise a dark coating on the first surface.

The fibre positioning head may also include a clearance aperture to provide a passage for the light through said structure before being redirected towards the first surface.

Preferably the clearance aperture is on the same plane as the fibre guide apertures.

Conveniently the fibre positioning head includes means for engaging one or more similar fibre positioning heads to provide a larger array of fibre optic ends to be illuminated. The means for engaging may comprise a peg on a first positioning head which slots into a receiving aperture on a second positioning head.

According to a second aspect of the present invention there is provided an optical scanner system for use as part of a display apparatus, the optical scanner system comprising:

one or more fibre optic positioning heads,

a steerable optical element, and

control means coupled to said steerable optical element and response to a control signal for directing the movement of said steerable optical element to reflect input from the optical element to said fibre optic positioning heads.

The one or more fibre optic positioning heads are as described hereinbefore. The steerable optical element may be a mirrored surface. Preferably, the mirrored surface is mounted on a spindle which, when rotated on a

vertical axis, turns the mirrored surface and causes the light incident on the mirrored surface to be reflected along a path which traverses a plane on the first surface in which said fibre positioning heads are disposed. The light traversing the first surface illuminates fibre optic ends located along the path.

By changing the direction and angle of rotation of the steerable optical element the directed light illuminates a desired sequence of fibre optic ends. Advantageously the steerable optical element may be rotated to direct the light onto a non-reflecting light absorbing surface located on the first surface when no illumination is required.

The control means for directing the steerable optical element may be a computer which generates a programmable electrical signal which operates a mirror positioning controller connected to the steerable optical element. Conveniently the mirror positioning controller drives a motor which rotates the spindle.

Advantageously, where more than one fibre positioning head is used, and the fibre positioning heads are disposed to provide more than one plane of the optical fibre ends, the control means for directing the steerable optical element also includes means to rotate the steerable optical element about an axis perpendicular to the axis of rotation to direct light into the optical fibres disposed on different planes.

The optical scanner system may include one or more steerable optical elements to direct light from one or more sources onto one or more fibre positioning head.

According to a third aspect of the present invention there is provided display apparatus comprising:

a laser light source,

an optical scanner system,

a plurality of optical fibres, at least some of which are side emitting optical fibres, and the optical fibres are arranged in a predetermined pattern or configuration

to form a visual display such that when the optical fibre ends are illuminated in a predetermined arrangement or sequence, different parts of the pattern or configuration are illuminated to give the perception of animation to an observer.

The laser light source may be any type of laser producing light but preferably is a solid-state laser which is, in turn, excited by a semiconductor diode laser. The laser may be provided with a programmable shutter, the shutter being closed when illumination is not required of an optical fibre end positioned between two optical fibre ends to be illuminated in sequence.

The shutter may be optical but preferably is mechanical.

Alternatively a programmable LCD shutter is used. Such a shutter is described in applicants co-pending application WO 98/45645

The shutter may be programmed and/or controlled by a computer.

The optical scanner system is as described hereinbefore, in which one or more fibre positioning heads, also described hereinbefore, position optical fibre ends to be illuminated by light which is directed from a steerable optical element. The optical scanner therefore directs laser light sequentially, in a pre-programmed order, into the optical fibre optic ends. The sequence may include periods where no optical fibre end is to be illuminated and at such periods the laser light may be directed at a non-reflecting light absorbing surface on the fibre positioning head or the laser light may be blocked by the shutter.

According to a fourth aspect of the present invention there is provided a method illuminating a plurality of optical fibres adapted to form part of a visual display so as to provide the perception of animation to an observer by providing a laser light source, an optical scanner system which comprises a fibre positioning head

and a controllable steerable optical element, and a plurality of optical fibres at least some of which are side-emitting optical fibres arranged to form part of a visual image, said method comprising the steps of:

energising the laser source to create a light beam,

controlling the steerable optical element in accordance with a predetermined signal so that laser light directed at the steerable optical element is redirected in a predetermined arrangement or sequence to said plurality of optical fibre ends so as to illuminate different parts of the visual image to give the perception of animation to an observer.

Preferably the method includes the step of using a programmable computer to generate control signals to the steerable element so that movement of the steerable optical element and opening and closing of an optical shutter can be pre-programmed before operating the display apparatus.

These and other aspects of the invention will become apparent from the following description when taken in combination with the accompanying drawings in which:

Figs. 1a, b are top and front views respectively of a fibre positioning head according to a first embodiment of the present invention;

Fig. 2 is a part cross sectional view, taken along line A-A^1 of Fig. 1b, through a fibre guide aperture modified in accordance with an alternative embodiment of the present invention;

Fig. 3 is a perspective view of an optical scanner system and associated display apparatus according to a second aspect of the present invention.

Reference is first made to Figs. 1a and 1b of the drawings which depict a fibre positioning head structure for use in a optical scanner as part of a display apparatus in accordance with a first aspect of the present invention. The fibre positioning head, generally indicated by reference numeral 2, is made from a single

piece of aluminium machined to form a front arcuate surface 6, the first surface, and a back arcuate surface 4, the second surface. Fibre guide apertures 8a-8f are drilled perpendicular to surfaces 4,6. The fibre guide apertures 8a-f are cylindrical and of sufficient diameter to receive an optical fibre to be inserted from the second surface 4 to the first surface 6. The fibre guide apertures are located equidistantly on the same plane. Fig. 1 shows six fibre guide apertures 8a-8f. However, it will be appreciated that any number of fibre guide apertures may be machined in the fibre positioning head 2. Optical fibres inserted into the fibre guide apertures 8 are located such that the optical fibre end is flush with the first surface 6.

In an alternative embodiment, shown in Fig. 2, an optical element such as a cylindrical lens 9 is mounted within the end of the fibre guide aperture 8 at the first surface 6 to focus light into the fibre optic end 13 of an optical fibre 11 located behind the optical element 9.

Each optical fibre 11 is held within the fibre positioning head 2 by means of a screw (not shown in the interest of clarity) inserted through a threaded aperture 12a-6 located above and into each fibre guide aperture 8a-f. The screw is tightened to secure the optical fibre 11 in the fibre guide aperture 8a-f. Between the first and second surfaces 4 and 6 a clearance aperture 10 is machined. This clearance aperture 10 is a vertical notch with a depth which extends at or beyond the lower edge of the fibre guide apertures 8.

In use laser light is directed through the clearance aperture 10. Also positioned on the first surface 6 is a non-reflecting light absorbing surface 7. The non-reflecting light absorbing surface 7 is a coating of black anodised paint providing a dark surface for the light to be absorbed upon and a rough finish with a larger surface area to radiate heat from the absorbed light.

The fibre guide apertures 8a-f, the clearance aperture 10 and the non-reflecting light absorbing surface 7 are equally spaced apart and positioned linearly across the first surface in the same plane. The spacing chosen ensures that light incident on an optical fibre guide aperture, 8b say, will not illuminate either of the fibre guide apertures 8a and 8c positioned adjacent to it.

Reference is now made to Fig. 3 of the drawings which depicts an optical scanner system for use in display apparatus in accordance with a second aspect of the present invention. The optical scanner system, generally indicated 20, comprises a fibre positioning head 2 as described in Figs. 1a and 1b, a steerable optical element, generally indicated by reference numeral 30, and control means 22,24, 26 for the steerable optical element 30. The steerable optical element 30 comprises a flat mirrored surface 27, mounted on a spindle 29 connected to a mirror positioning controller 28 of a type disclosed in U.S. Patent No. 5671043. The mirror positioning controller 28 rotates the spindle 29 about a vertical axis thus also rotating the mirrored surface 27. The optical steering element 30 is positioned with respect to the fibre positioning head 2 such that light incident on the mirrored surface 27 is reflected onto the first surface 6 of the fibre positioning head 2. The mirror positioning controller 28 rotates the spindle 29 and rotates the mirrored surface 27 such that the reflected light traverses a plane on the first surface 6 in which the optical fibre ends with the fibre guide apertures 8 are located. The motor 28 is controlled via a personal computer 22, a microcomputer 24 and a digital to analogue converter 26. The digital to analogue converter 26 includes an amplifier with gain and zero offset controls.

The microcomputer 24 performs the sequencing of the mirror's angular position according to a stored program. The output from the microcomputer 24 is a sequence of

voltages which are sent out as digital values to a digital to analogue converter 26, which generates analogue voltages, which are amplified. The degree of amplification and the offset of the amplified voltage output can be adjusted by the gain and zero offset controls. This is necessary to ensure that the final resting positions of the reflected light coincide with the geometrical positions of the fibre guide apertures 8 in which the optical fibres 11 are located.

The amplified voltages are sent to the mirror positioning controller 28 which generates corresponding currents to rotate the mirrored surface 27. The mirror positioning controller 28 is a piece of proprietary electronics which accompanies the rotating mirrored surface 27, and which is "tuned" by the manufacturer to suite the mechanical and electrical characteristics of the mirror and its drive coil. Such a mirror positioning controller 28 is disclosed the U.S. Patent No. 5,671,043 (Ivers).

In use, a laser light beam which is incident on the mirror is deflected by reflection into a reflected beam which can be aimed in any required direction, within the angular arc of rotation of the mirrored surface 27 by a suitable digital voltage value output from the microcomputer 24. The dwell time at one position is the time between the output of this digital voltage value and the next.

A sequence of voltages and dwell times is stored in non-volatile storage within the microcomputer 24 and is therefore fixed. For greater flexibility the microcomputer 24 is linked (perhaps via a serial port) to a personal computer 22 such as a laptop or palmtop computer. Via this line, new sequences can be downloaded into the microcomputer 24 easily. This is a particularly useful feature during the formulation phase of a new sequence because it facilitates modification of the angles and dwell times.

In applications where flicker would be observed, dwell times have to be of the order of a few milliseconds.

The display apparatus, generally indicated by numeral 40, comprises an optical scanner 30 together with a laser 42, a plurality of side emitting optical fibres 11 and a display 45. The display 45 is an arrangement of the optical fibres 11 into a predetermined pattern or configuration to form a visual display.

The laser light source 42 consists of a semi-conductor diode-laser pumped solid-state laser (dpssl) which is a neodymium yttrium orthovandate ($Nd:YVO_4$) laser with intra-cavity frequency doubling to produce light at a wavelength of 532 nanometres (nm). The laser 42 produces a laser beam 1mm in diameter which exits the laser at a light power of up to 1 Watt. An electro-optic shutter is fitted to the output of the laser 42 in the path of the laser beam.

The laser beam is fired between the clearance aperture 10 at the mirrored surface 27 of the steerable optical element 30. The light is reflected at a predetermined angle towards the fibre positioning head 2.

The light traverses across the first surface 6 of the fibre positioning head 2 in a sequence determined from the digital voltage value output from the microcomputer 24, as preprogrammed into the personal computer 22.

In use the personal computer 22 is programmed with a sequence of voltages and dwell times. The voltages and dwell times are stored in the microcomputer 24. The voltage and dwell times are used to control the mirrored surface 27 from the mirror positioning controller 28. The light from laser 42 is redirected from the mirror surface 27 to be incident on a predetermined fibre guide aperture 8 into which is located a fibre optic 11 which is part of an arrangement of optical fibres comprising a visual display 45. The light beam delays for a dwell time on the fibre guide aperture 8a before the light

traverses the first surface 6 to dwell on another fibre guide aperture 8b. The fibres 41a and 41b located within the fibre guide apertures 8a and 8b from geometrical segments of a visual display 45. The time sequence of illumination of these segments of fibres 41a and 41b gives the impression of an animated picture.

It will be appreciated that various modifications may be made to the embodiments hereinbefore described without departing from the scope of the invention. For example, a multiplicity of fibre positioning head and/or different coloured sources of laser light may be used to increase the complexity and detail of the visual display.

The advantages of the present invention are primarily in the flexibility to rearrange the optical fibres to create a new visual image and the personal computer can be used to reprogram the sequence of voltages and dwell times to provide the perception of animation to the new visual display.

CLAIMS

1. A fibre optic positioning means for an optical scanner used with display apparatus said positioning means comprising a structure with a plurality of locating means for receiving and locating a plurality of optical fibres in a predetermined array to position optical fibre ends for illumination by a directed light beam.

2. A fibre optic positioning means according to claim 1 wherein the locating means is provided by a plurality of fibre optic guide apertures disposed in said structure.

3. A fibre optic positioning means according to claim 1 or claim 2 wherein the structure has first and second surfaces parallel to each other.

4. A fibre optic positioning means according to claim 3 wherein the plurality of fibre optic guide apertures are located between the first surface and the second surface, and are disposed in a common plane in said structure.

5. A fibre optic positioning means according to any one of claims 2 to 4 wherein the optical fibre ends are located within each fibre guide aperture to align the optical fibre ends with the first surface.

6. A fibre optic positioning means according to any one of claims 2 to 5 wherein the or each locating means includes securing means to secure the optical fibres in the respective fibre guide apertures.

7. A fibre optic positioning means according to claim 6 wherein the securing means is provided by a threaded aperture in which a screw is located for securing the optical fibre in the fibre guide aperture.

8. A fibre optic positioning means according to claim 6 wherein the securing means is an adhesive material.

9. A fibre optic positioning means according to any one of claims 2 to claim 8 wherein an optical component is mounted within each fibre guide aperture near the first surface to focus the light beam into the fibre optic end.

10. A fibre optic positioning means according to claim 9 wherein the optical component is a lens.

11. A fibre optic positioning means according to any one of claims 3 to 10 wherein the first and second surfaces are curved.

12. A fibre optic positioning means according to any one of claims 2 to 11 wherein the fibre guiding apertures are located equidistantly apart and on the same plane in said structure.

13. A fibre optic positioning means according to any preceding claim wherein the fibre positioning means includes at least one non-reflecting light absorbing surface area so that the light may be directed at the non-reflecting light absorbing surface area when illumination of the optical fibre ends is not required.

14. A fibre optic positioning means according to claim 13 wherein the first surface includes the non-reflecting light absorbing surface.

15. A fibre optic positioning means according to claim 13 or claim 14 wherein the non-reflecting light absorbing surface comprises a dark coating on the first surface.

16. A fibre optic positioning means according to any

preceding claim wherein the fibre positioning means includes a clearance aperture to provide a passage for the light beam through said structure before being redirected towards the first surface.

17. A fibre optic positioning means according to claim 16 wherein the clearance aperture is on the same plane as the fibre guide apertures.

18. A fibre optic positioning means according to any preceding claim wherein the fibre positioning means includes means for engaging one or more similar fibre positioning means to provide a larger array of fibre optic ends to be illuminated.

19. A fibre optic positioning means according to claim 18 wherein the means for engaging comprises a peg on a first positioning means which slots into a receiving aperture on a second positioning means.

20. An optical scanner system for use as part of a display apparatus, the optical scanner system comprising:
one or more fibre optic positioning heads,
a steerable optical element, and
control means coupled to said steerable optical element and response to a control signal for directing the movement of said steerable optical element to reflect input from the optical element to said fibre optic positioning heads.

21. An optical scanner system according to claim 20 wherein the one or more fibre optic positioning heads are fibre positioning means according to any one of claims 1 to 19.

22. An optical scanner system according to claim 20 or

claim 21 wherein the steerable optical element is a mirrored surface.

23. An optical scanner system according to claim 22 wherein the mirrored surface is mounted on a spindle which, when rotated on a vertical axis, turns the mirrored surface and causes the light incident on the mirrored surface to be reflected along a path which traverses a plane on the first surface in which said fibre positioning heads are disposed.

24. An optical scanner system according to any one of claims 20 to 23 wherein the control means for directing the steerable optical element is a computer which generates a programmable electrical signal which operates a mirror positioning controller connected to the steerable optical element.

25. An optical scanner system according to claim 24 wherein the mirror positioning controller drives a motor which rotates the spindle.

26. An optical scanner system according to any one of claims 21 to 25 wherein a plurality of fibre positioning heads are disposed to provide more than one plane of the optical fibre ends.

27. An optical scanner system according to claim 26 wherein the control means for directing the steerable optical element also includes means to rotate the steerable optical element about an axis perpendicular to the axis of rotation to direct light into the optical fibre ends disposed on different planes.

28. An optical scanner system according to any one of claims 20 to 27 wherein The optical scanner system includes one or more steerable optical elements to direct

light from one or more sources onto one or more fibre positioning heads.

29. Display apparatus comprising:
a laser light source,
an optical scanner system,
a plurality of optical fibres, at least some of which are side emitting optical fibres, and the optical fibres are arranged in a predetermined pattern or configuration to form a visual display such that when optical fibre ends of the optical fibres are illuminated in a predetermined arrangement or sequence, different parts of the pattern or configuration are illuminated to give the perception of animation to an observer.

30. Display apparatus according to claim 29 wherein the laser light source is a laser producing a light beam.

31. Display apparatus according to claim 30 wherein the laser is a solid-state laser which is, in turn, excited by a semiconductor diode laser.

32. Display apparatus according to claim 30 or claim 31 wherein the laser is provided with a programmable shutter, the shutter being closed when illumination is not required of an optical fibre end positioned between two optical fibre ends to be illuminated in sequence.

33. Display apparatus according to claim 32 wherein the shutter is optical.

34. Display apparatus according to claim 32 wherein the shutter is mechanical.

35. Display apparatus according to claim 32 wherein the shutter is a programmable LCD shutter.

36. Display apparatus according to any one of claims 32 to claims 36 wherein the shutter is programmed and/or controlled by a computer.

37. Display apparatus according to any one of claims 29 to 36 wherein the optical scanner system is according to any one of claims 20 to 28.

38. Display apparatus according to claim 37 wherein the one or more fibre positioning heads are fibre positioning means according to any one of claims 1 to 19.

39. A method of illuminating a plurality of optical fibres adapted to form part of a visual display so as to provide the perception of animation to an observer by providing a laser light source, an optical scanner system which comprises a fibre positioning head and a controllable steerable optical element, and a plurality of optical fibres at least some of which are side-emitting optical fibres arranged to form part of a visual image, said method comprising the steps of:

energising the laser source to create a light beam,

controlling the steerable optical element in accordance with a predetermined signal so that the light beam directed at the steerable optical element is redirected in a predetermined arrangement or sequence to optical fibre ends of said plurality of optical fibres so as to illuminate different parts of the visual image to give the perception of animation to an observer.

40. A method according to claim 39 wherein the method includes the step of using a programmable computer to generate control signals to the steerable optical element so that movement of the steerable optical element and opening and closing of an optical shutter can be pre-programmed before operating the display apparatus.

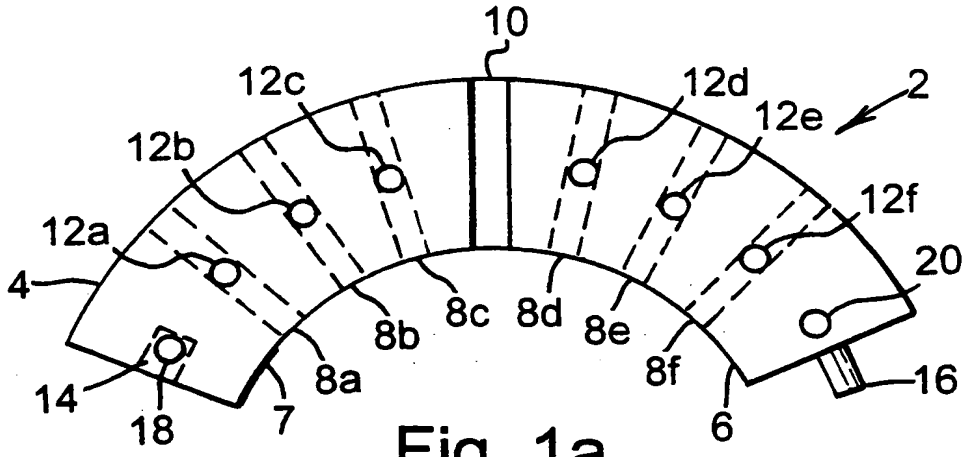

Fig. 1a

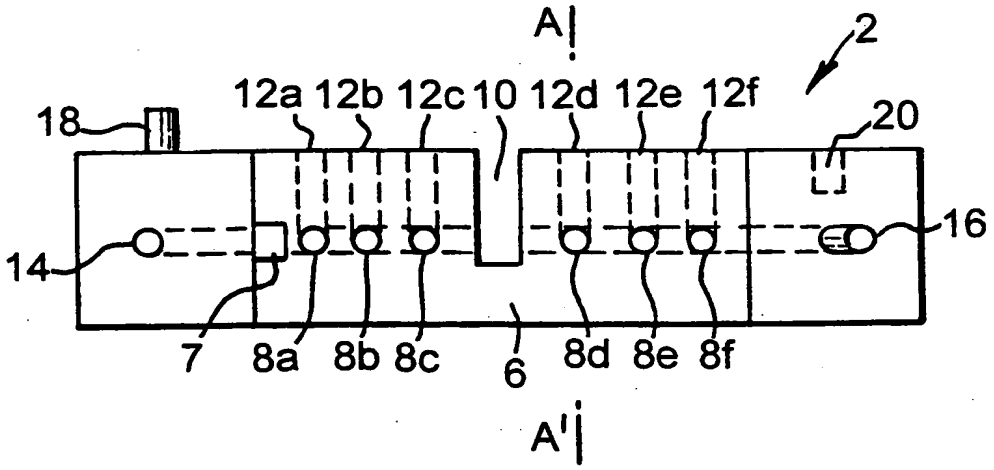

Fig. 1b

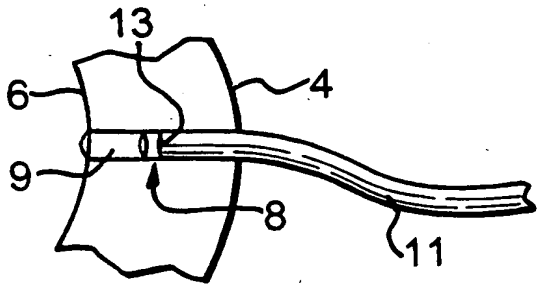

Fig. 2

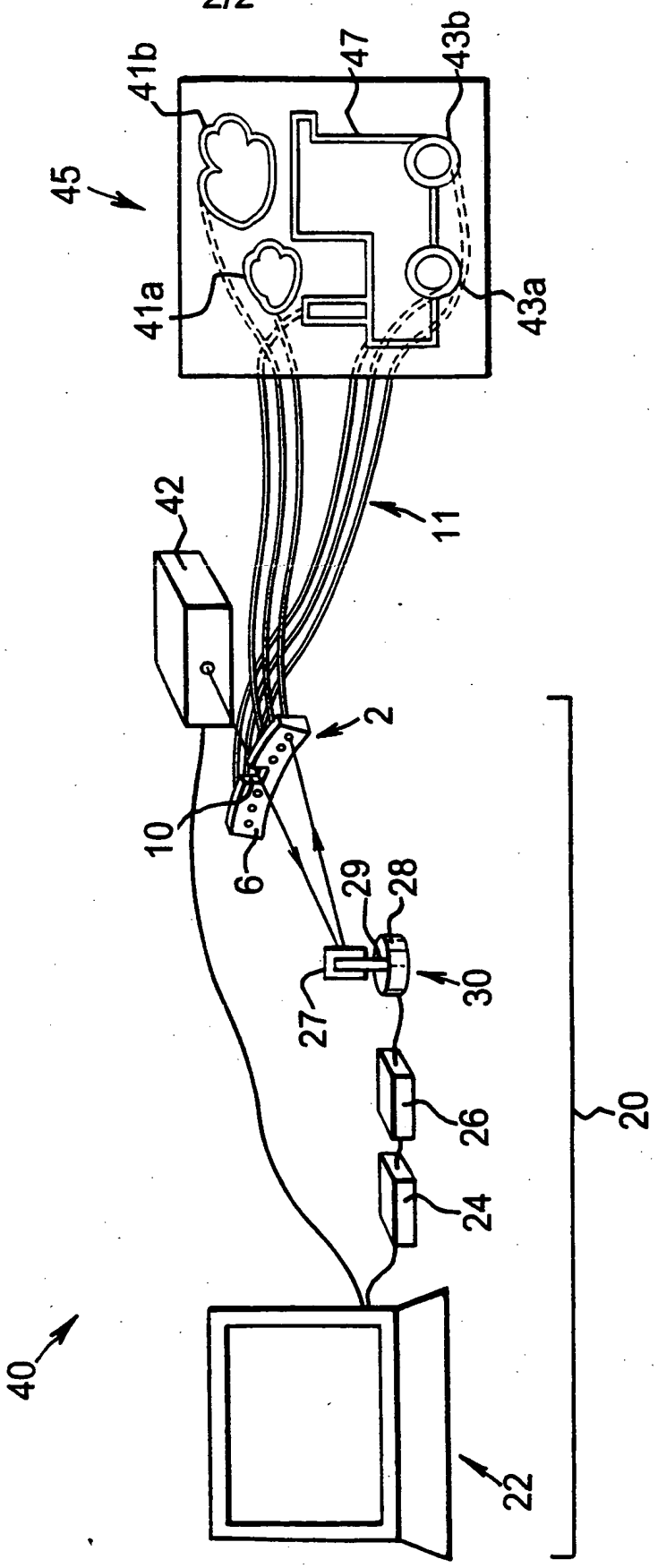

Fig. 3

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/GB 99/03108

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F21V8/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F21V

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 44 42 347 A (HENNING FASEROPTIK GMBH) 30 May 1996 (1996-05-30) column 6, line 12 - line 31; figures	1,4
A	DE 27 32 805 A (BARTENBACH CHRISTIAN) 8 February 1979 (1979-02-08) figures	1-3,5, 11,12
A	DE 19 21 138 A (ANKER-WERKE) 29 October 1970 (1970-10-29) the whole document	1-4,6,7, 11,12
A	WO 98 35181 A (ENDE MICHAEL ;TRIBELSKY ZAMIR (IL)) 13 August 1998 (1998-08-13) page 18, paragraph 3 -page 22, paragraph 1 page 36, paragraph 1 -page 37; figures 8,12	1,2

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
17 December 1999	12/01/2000

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INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/GB 99/03108

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 791 758 A (FELDE THEODORE ET AL) 11 August 1998 (1998-08-11) column 3, line 19 -column 4, line 48	1,39

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 99/03108

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 4442347 A	30-05-1996	NONE	
DE 2732805 A	08-02-1979	NONE	
DE 1921138 A	29-10-1970	NONE	
WO 9835181 A	13-08-1998	AU 5876498 A	26-08-1998
US 5791758 A	11-08-1998	AU 7022498 A	13-11-1998
		CA 2208287 A	22-10-1998
		WO 9847586 A	29-10-1998